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RANDOM NOTES ON VISITING THE USSR

by

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# RANDOM NOTES ON VISITING THE USSR

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From March 17 to 23, 1989, the International Laser and Applications Symposium was held near Zvenogorsk on the Yenisei River, south of Krasnoyarsk in Novosibirskaya Oblast of the Soviet Union. This was one of the international academic symposia on advanced science and technology held by the Soviet Union for the first time since the glasnost policy of opening to the world. Those invited from China included president Liu Songhao of the Huanan Normal University (he was not present), Chen Tianjie and Guo Yinghua of Beijing University, Lu Yiqun of the Anhui Institute of Optics and Fine Mechanics, Li Zaiguang, Han Yansheng, and Guo Zhenhua of the Huazhong University of Science and Technology, among others. After the symposium, Li Zaiguang, Han Yansheng, and Guo Zhenhua visited universities and research organizations, as well as laser device production and laser application research centers in Moscow, Leningrad, and

Vilnius, the capital of the republic of Lithuania. The entire trip covered about 20,000km.

The consortium was sponsored and funded by the Krasnoyarsk Youth Research and Engineering Center, jointly organized by eight units including the European Physical Society, the USSR Academy of Sciences, and Moscow University.

The symposium chairmen were academicians A. M. Prokhorov, one of the pioneers in laser research and the 1964 Nobel Prize Winners in physics, and the director of the Physics Institute of the USSR Academy of Sciences, and academician K. S. Aleksandrov, director of the Physics Institute, Krasnoyarsk Division of the USSR Academy of Sciences. The meetings were chaired by doctor A. K. Popov of the Krasnoyarsk Institute of Physics of the USSR Academy of Sciences.

From the United States, China, Cuba, The Netherlands, Poland, German Democratic Republic, Belgium, Romania, Italy, Hungary, and the Federal Republic of Germany, and various oblasts of the Soviet Union, more than 150 delegates attended the symposium. There were seven Chinese delegates (with one absence), making China the country with the most delegates invited from abroad. Moreover, Liu, Chen, Zou, Guo, and Lu assumed some duties in the symposium. During the symposium, reports were given on high-powered $CO_2$ lasers and their applications in China by Li Zaiguang, on collision-induced nonlinear processes by Zou Yinghua, on resonant nonlinear optical processes in metal vapors by Chen Tianjie, research on the

$BeAl_2O_7Cr^{+3}$ oscillation spectrum by Lu Yiqun, and research on excimer laser spectra by Guo Zhenhua. Lu reported on laser applications in China.

There were more than 100 papers reported and posted during the symposium. There were two lecture times: 45 and 25min; however, there was no strict controls on time, owing to the vigorous discussion. The main topics were the physical foundations of laser applications, laser applications in surface processing of materials, thin-film laser preparation and thin-film structures, recording and processing of laser data, laser applications in medicine, biology, and other fields, as well as trends in laser engineering, equipment, and technical development. There were 12 aspects as to program schedules: (1) medical applications of lasers; (2) laser technique and instrumentation; (3) laser processing of material surfaces; (4) laser applications in biomedicine; (5) fundamental problems of quantum optics; (6) laser device systems; (7) processing of optical information; (8) drift of photo-atoms; (9) drift of photo-atoms and molecules; (10) photodynamics effect; (11) symposium on gas-phase photodynamics in the USSR and Germany; and (12) symposium on quantum optics in the USSR and China.

The languages used during the symposium were English and Russian, with mutual translations. The symposium was lively, especially when it came to reports and papers by Soviet specialists. Generally, the theoretical analysis was relatively

well-detailed, with rigorous mathematical derivations. The Soviets also liked to discuss back and forth on interesting problems from different approaches. Some aspects of the symposium appeared to lack experience and maturity, resembling the starting period of China's opening to the world. However, generally, the various qualities in the symposium were quite high. Each delegate had many opportunities to speak and question, expressing his or her academic thinking for in-depth discussion. As an illustration, the authors had more than eight opportunities for questioning and speaking out. The atmosphere was quite different from conventional international symposia, limited to only 15min of speaking and 3 to 5min of questioning. However, since the time for lecturing and discussion was not strictly controlled, every day the meetings lasted very late into the night. However, the delegates did not complain, commonly not leaving until midnight. From the papers presented at the symposium, the Soviet specialists displayed refined logic in theoretical derivations and model selection, rigorous mathematical computations, and detailed analysis of experimental results, including new concepts based on fundamental scientific principles, for example, the cluster model. This was in high contrast to the West, where numerous advanced items of equipment, computers, and a wealth of funding as the backup, with large numbers of experimental studies, as is the case with some pioneering experts in the West. In the authors' view, from the reality in China with its lack of abundant economic resources, in

a situation of tight supply of funding, there are many good points in the practice of conducting key research efforts effectively in the Soviet Union. For example, through cooperation among Soviet physicists and biologists with their limited laser equipment, some very high-level research results were accomplished. Most tasks in the laser medical applications were out of the phenomenological or practical realm; discussions were mostly from typical disease cases deep into the molecular level. At present, the extensively applied YAG laser surgical equipment in medicine in China uses mostly 1.06mum laser beams. At this symposium, doctor D. Dove of the Orlando Medical Center in the United States reported multiple clinical treatments with 1.32mum infrared laser beams from a YAG laser device, with many advantages. With computer control of the system, the doctor successfully conducted large numbers of experiments on laser-assisted tissue coalescence. The experiments indicate that water and blood absorb less from a 1.32mum laser than from a 1.06mum laser. If this is true, with some remodeling (by changing the resonator chips) of the YAG laser surgical apparatus in China, such devices can be applied more effectively, thereby opening up the international marketplace. Based on discussions by the authors with the Soviet medical work units at the symposium, they expressed great interest in purchasing, if barter trade can be arranged, laser surgical devices made in China.

Lenin's nameplace has its sights. During the symposium, besides more than 10min of an enthusiastic welcoming speech by

the local party committee secretary at the opening ceremony, weekend tour groups were organized to visit Lenin's residence when exiled to Siberia (including his living-quarters, study, and family quarters), as well as several log barracks nearby. Before the symposium and in the breaks between symposium sessions, we also visited the Lenin Museum, the local Museum of Nature and the History Museum, among others. Long guided-tour explanations stirred quite a few people, as someone mused, "This is a forced revolutionary education on traditions." We spent a pleasant night in a theater with the local well-known authors, painters, pianists, and folk musical performers (accordionists) with the delegates. This was quite a unique and highly elegant activity, showing the local customs in socialism with good amusements, because of the lack of a dirty-money atmosphere, with mingling between performers and audience to be entertained. The atmosphere expressed enthusiastic and mutual respect among the people (authors, artists, and scientists), with the precious mingling of literature, the arts, and the sciences. Although only several hours were spent by each participants, yet mutual respect, harmony, sincerity, and elegance reigned, for the struggle of the fortunes of all mankind; we thought that such meetings were only to be found in dreams, among authors, artists, and scientists. Another meeting during the symposium between Chinese specialists and the Soviets lasted a night. Because of the gap between ages and educational background, naturally the atmosphere was a little restrained at the beginning, with

questions and answers, but it became relaxed quickly afterwards, with singing, dancing, and accordion-playing. They are very curious about the reform and the opening to the world in China as well as traditional Chinese culture, such as the martial arts, Taichi, and Qigong. They sincerely wished that the friendship between the USSR and China can quickly develop with ever-increasing exchanges between the two countries.

In the morning on the eve of the symposium's opening, Liu Yiqun and the authors were accompanied by the deputy director of the Krasnoyarsk Institute of Physics to visit equipment in laboratories at the institute; brief talks were exchanged with researchers. The tall deputy director was enthusiastic and spoke good English. On some occasions, he was the English interpreter during the visit, to explain the research context in the laboratories, showing his high scientific level and superb leadership ability. At present, the Krasnoyarsk Branch of the Siberian Division of the USSR Academy of Sciences is headed by academician A. S. Isaev. Under the division there are the Physics Institute, the Institute of Biophysics, the Institute of Dendrology, the Computer Center, as well as the Institute of Chemistry and Chemical Engineering, among others. The research buildings are dispersed on the right bank of the Yenisei River, with convenient communication. A large computer building is located on a grassy area in the central region of these institutes; this is the Computer Center for online public access. Moreover, there were high-tech items such as lasers, atomic

physics, and biological techniques. Since there are abundant mineral reserves and large forested areas in Siberia, many scientific projects are closely related to the urgent requirements in the national economy. Good accomplishments were obtained in the structure of metallic materials, performance of ferromagnetic substances, and tree growth. Multiple awards were granted due to their leading positions in such activities.

On conclusion of the symposium, the Chinese delegates returned to China in two groups. Li Zaiguang, Han Yansheng, and Guo Zhenhua visited Moscow University and the Lithuanian capital, Vilnius. With a history of more than four centuries, Vilnius University is a comprehensive university, including the literary arts, science, medicine, and engineering. Quite a few world-renown persons, such as Lev Tolstoy, have studied or worked there. At present, the university is located at several locations in older zones and several in new buildings; its scientific level is quite high. With respect to laser science, research is led by the internationally well-known professor, Piscarskas in a teaching setting. They performed quite a few activities with ultrashort pulses, four-wave mixed frequencies, and laser spectra. At present, cooperation is underway between Vilnius University and the laboratories of the physics department of Moscow University on the interconversion and generation regime of biology-light energy and chemical energy, in order to clarify some substantial problems regarding highly-efficient photosynthesis of light. This is undoubtedly a leading-edge

project that remains to be solved for many years in the world. Laser teaching in the university can serve as our reference point. Their professors only provide the major laser devices and instrumentation required in a project to students, but do not tell students how to proceed. Students can independently make and design, for their experimentation, in order to attain brand-new and creative results.

Under the Lithuanian Academy of Sciences, the Institute of Laser Applications is situated among buildings in a wooded setting of Vilnius. The institute mainly conducts laser research on industrial applications, including technical studies on welding, cutting, and drilling with $CO_2$ laser devices. As related by a responsible person regarding their patent on laser processing of metal pipe, the patent is very valuable in petroleum extraction, utilization of water resources, and environmental protection. They enthusiastically requested cooperation with scientific, technological, and economic circles in China for mutual benefits. Most of the laser devices used in their laboratories were purchased in the USSR or developed by themselves, including one set of a $CO_2$ laser device equivalent to the level of a few years ago in China. Like Vilnius University, the operation and management style of the institute resemble that of the developed countries in the West, seeming to be a level higher than other institutes (such as Krasnoyarsk Institute of Physics and the Moscow Institute of General Physics) of the USSR Academy of Sciences. The urban area of Vilnius has plenty of

verdure, with modern buildings and autobahns in the suburbs. There are plenty of privately owned cars. This gives us a feeling of highly modern lifestyle. Vice president Grigonis (Ph. D.) of Vilnius University is capable and alert. He sincerely wishes that his university can conduct academic exchanges and joint research with universities (including medical colleges) in China.

At the Kalinin Engineering College, at which comrade Li Zaiguang studied in the sixties, in Leningrad, we visited laser laboratories and machine shops of the college. Although their equipment is much better than that of Vilnius Institute, other than items of laser equipment (such as excimer laser devices) made in the USSR, there are imported laser products from U.S. companies via Bulgaria and other nations. In addition, there are brand-new machine shops, equipped with multiple machine tools controlled by computer programs for cutting and welding in complex shapes. The leading personnel are young professors who also teach at the college.

In Moscow, first we conducted a more detailed visit on laser research projects at the Institute of General Physics. Liaison director S. S. Alimpiev of the institute, who took part at the Zvenogorsk Symposium, accompanied us for making explanations or translations. There, visiting researchers from Cuba, Democratic Republic of Germany, and Poland, were working together. They have very active research programs in coherent optics, nonlinear optics, laser devices, and independent components, with good

achievements. For example, the world-class level was reached on $CO_2$ laser series (in particular, the large research facilities of the electron beam pump, x-ray pump, and discharge pump), excimer laser series (similar to the products of Lambda-Physik Corporation in West Germany), infrared and far-infrared optical fibers (such as 10.6mum $CO_2$ fiber optics), and special instrumentation. Products from these accomplishments are supplied throughout the Soviet Union and East Europe. The fundamental theoretical research of the institute is at a high level. There are many papers published in first-rate scientific journals, such as Laser Spectroscopy (such as mass spectra induced and generated in flight in gases or on solid surfaces with pulsed laser), laser chemistry, laser biology, and laser physics. For example, there was a laser engine illuminated with a 2W $Ar^+$ laser beam on an absorption target containing 25g of an organic dyestuff solution; the container was moved at a velocity of 1cm/s on a horizontal support. The director of the Institute of General Physics was elected. The present director is a pioneer in laser research, A. M. Prokhorov, an academician and a member of the executive committee of the USSR Academy of Sciences. Together with academician N. G. Basov, they published a paper, "Molecular Generators." In 1955, another paper was published on a new method of pulsed stimulation of atomic systems. Both shared one-half of the 1964 Nobel Prize awards (the other half was shared by C. H. Townes, an American). Prokhorov is concurrently also a professor at Moscow University,

an honorary professor of Delhi University and the University of Bucharest, an honorary academician at the National Academy of Sciences in the United States, and chief editor of the Great Soviet Encyclopedia. On the afternoon of April 4, we were lucky to have about one hour of friendly talks. Finally, a photograph was taken in his office (Fig. 1). On my (Guo Zhenhua) request, he signed and wrote in enthusiastic friendly language: "I am very glad to discuss various problems regarding future cooperation, with the Chinese delegates." (Fig. 2) We deeply felt that this scholar honored with the title of Socialist Hero of Labor was so easy-going. When we departed, we presented him with an embroidered bear, in Hunan style, and we expressed our sincere invitation for him to visit China at a convenient time. He responded that he would visit other nations this year. In the future, he will be glad to visit China, if the time can be arranged.

We prepared to visit Basov when we were still in China. Although he is not only a pioneer in laser research, but also one of the authorities in the present-day laser field in the world. He is six years younger than Prokhorov. He was formerly director of the Lebedev Institute of Physics. More than 300 scientific papers were published by him. In 1958, he was the first to use semiconductors to fabricate a laser device. In 1968, he was successful in thermonuclear reactions by concentric implosion with a laser beam. He is a member of the Supreme Soviet and concurrently a professor of the Moscow College of Engineering

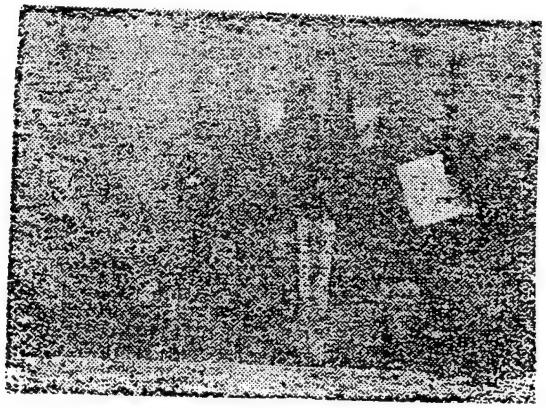

Fig. 1. Photograph in the office of academician A. M. Prokhorov, together with Li Zaiguang, Han Yinsheng, and Guo Zhenhua. The paper held in Guo's right hand has the note by Prokhorov.

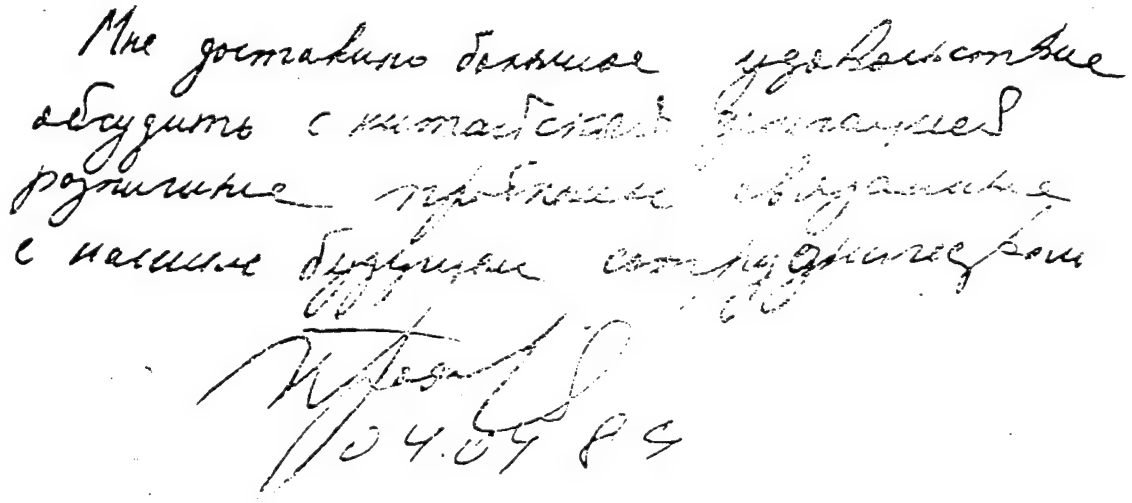

Fig. 2. Note and signature (refer to text) presented by academician A. N. Prokhorov to Guo Zhenhua and other comrades. "I am very glad to discuss various problems regarding future cooperation, with the Chinese delegates" (April 4, 1989).

Physics. He was chief editor of Priroda and Kvantovaya Elektronika and chairman of the All-Soviet Znanie [Knowledge] Society, Internationally, he has numerous honorary titles.

During the 1981 International Laser Conference, the authors talked with him in New Orleans, United States. He expressed his willingness to visit China, but the political climate then was not propitious. Although there was correspondence, the China visit was not realized because of our reasons. At that time, our photographs and signatures only remained on a page in a book that he gave us. Of greater regret was the fact that Basov was not met because of tight schedules and arrangements in the USSR. Dr. Alimpiev introduced that he placed his main energies and funding in several important projects, such as military lasers, high-energy laser systems, laser nuclear fusion, excimer lasers, and semiconductor lasers. He decidedly cut off many generalized research topics to show his strong decision-making power of this work style. He was awarded a Lenin Medal and the title of Hero of Socialist Labor, as well as honorary titles awarded by scientific organizations in Bulgaria, Czechoslovakia, Germany, Poland, Sweden, the United States, Hungary, and Italy. He is a member of the Central Committee of the Soviet Communist Party, and a high-level official in the government. His schedule is very business like and ordinary people find it very difficult to see him.

The last station of the Soviet visit was at Satula Laser Center; the visit was arranged while we were still in China. Satula is the location of a newly-built research and manufacturing center of high-power industrial $CO_2$ laser devices, with a power station near by for abundant power supply. There

are lakes, forests, and beautiful scenery. Electric trains and automobiles connect Satola with Moscow with convenient transportation. At present, there are approximately more than 1200 working personnel: the engineering and technical personnel, workers, and cadres each account for about one-third, for the production of $CO_2$ laser series of 500, 800, 1000, 2000, and 5000W, sold throughout the USSR and East Europe. The world market of the series is being actively promoted. In an exhibition hall at the center are displayed, with many products and project descriptions, with international exchanges, including some data from Changchun, China. The center's director is G. A. Abilsiitov, who is young, energetic, and decisive, willing to conduct active cooperation and exchange with China, under the precondition of opening up markets in China. The center is a key engineering project of the state, with large-sized buildings, shops, and modern equipment, such as computer-controlled diamond-cutting lathes. All are automated and converted to series-production from the original workpiece (even the raw material) to the design, machining, assembly, and testing into complete sets of laser equipment. This is a high-tech trust-sized facility, with high competitiveness. We visited machine shops, laboratories, and office command systems, sensing the gigantic resources of high-tech in the Soviet Union. We felt deeply that the Satola Laser Center is an ideal model that our country needs as calling for more than a decade from party, government, as well as science and technological circles. The model has been

realized in the Soviet Union; this will have multiple effects on the national economy. Most likely, we will quickly concentrate our manpower and material resources to build a similar center, which may be better than theirs!

This Soviet conference and visit was a quite successful and satisfactory scientific investigation, with many gains in various respects.

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